CLAIMS

We claim:

1. A system for determining the orientation of an object relative to a source of electromagnetic radiation comprising:

a plurality of sensors, each of the sensors producing a corresponding output signal when placed in the path of electromagnetic radiation emitted by a source; and

a controller for receiving the output signals of the sensors, and for determining the orientation of the object relative to the source based on the sensor output signals.

2. The system of claim 1 wherein the source of the electromagnetic radiation is the sun.

3. The system of claim 1 wherein the electromagnetic radiation is of a type selected from the group consisting of visible radiation, infrared radiation, and ultraviolet radiation.

4. The system of claim 1 wherein the sensors are optical sensors.

5. The system of claim 4 wherein the optical sensors comprise photodiodes.

6. The system of claim 5 wherein the output signals are derived from the intensity of light radiation received at the photodiodes.

7. The system of claim 1 wherein each of the sensors has a corresponding viewing angle having a center line, and wherein the center lines are at known orientations relative to each other.

8. The system of claim 1 wherein the center lines of the respective sensors are at angles relative to each other.

9. The system of claim 8 wherein the center lines lie on a plane.

10. The system of claim 8 wherein the center lines intersect at a common point.

11. The system of claim 1 wherein the controller samples multiple sets of the sensor output signals at periodic time intervals.

12. The system of claim 11 wherein determining the orientation of the object is based on multiple sets of the sensor output signals.

13. The system of claim 1 wherein the controller further:

determines a subset of the output signals of the sensors having signal levels that are greater than those of other output signals;

fits a polynomial to the output signals of the subset;

determines one of a maximum and minimum of the polynomial; and

determines the orientation of the object based on the one of the maximum and minimum.

14. The system of claim 13 wherein the subset includes at least three of the sensor output signals.

15. The system of claim 1 wherein the controller determines the orientation of the object further based on a known factor of the type of a type selected from the types consisting of: time, latitude, longitude, and altitude.

16. The system of claim 1 wherein the controller determines the orientation of the object further based on a theoretical determination of the electromagnetic radiation source position.

17. The system of claim 16 wherein the controller further determines the orientation of the object by comparing the theoretical determination of the electromagnetic radiation source position to an actual determination of the position based on the sensor output signals.

18. A system for determining the orientation of an object relative to a source of electromagnetic radiation comprising:

a two-dimensional array of sensors, each of the sensors producing a corresponding output signal when placed in the path of electromagnetic radiation emitted by a source;

a lens for directing the electromagnetic radiation from the source onto the two-dimensional array; and

a controller for receiving the output signals of the sensors, and for determining the orientation of the object relative to the source based on the sensor output signals.

19. The system of claim 18 wherein the two-dimensional array of sensors comprises a charge-coupled device (CCD) array.

20. The system of claim 18 wherein the two-dimensional array of sensors comprises a bolometer array.

21. The system of claim 18 wherein the source of the electromagnetic radiation is the sun.

22. The system of claim 18 wherein the electromagnetic radiation is of a type selected from the group consisting of visible radiation, infrared radiation, and ultraviolet radiation.

23. The system of claim 18 wherein the sensors are optical sensors.

24. The system of claim 23 wherein the optical sensors comprise photodiodes.

25. The system of claim 24 wherein the output signals are derived from the intensity of light radiation received at the photodiodes.

26. The system of claim 18 wherein the output signals of the sensors are binary signals that indicate those sensor elements of the two-dimensional sensor array that are activated in response to receiving the electromagnetic energy at a level above a predetermined threshold.

27. The system of claim 26 wherein the controller determines the orientation of the object based on multiple samples of the sensor output signals taken at predetermined time intervals.

28. The system of claim 27 wherein the controller further:

tracks elements of the sensor array that are activated at each sample interval;
fits a polynomial to the activated sensor elements over time;
determines the orientation of the object based on the polynomial.

29. The system of claim 18 wherein the controller determines the orientation of the object further based on a known factor of a type selected from the types consisting of: time, latitude, longitude, and altitude.

30. The system of claim 18 wherein the lens comprises a pinhole in a housing body containing the two-dimensional array of sensors.

31. The system of claim 18 wherein the controller determines the orientation of the object further based on a theoretical determination of the electromagnetic radiation source position.

32. The system of claim 16 wherein the controller further determines the orientation of the object by comparing the theoretical determination of the electromagnetic radiation source position to an actual determination of the position based on the sensor output signals.

33. A method for determining the orientation of an object relative to a source of electromagnetic radiation comprising:

receiving, at a plurality of sensors, electromagnetic radiation emitted by a source, each of the sensors producing a corresponding output signal in response to the received electromagnetic radiation;

determining an actual position of the source of electromagnetic energy based on the sensor output signals;

computing a theoretical position of the source of electromagnetic energy; and

comparing the actual position to the theoretical position to determine the orientation of the object.

34. The method of claim 33 wherein the source of the electromagnetic radiation is the sun.

35. The method of claim 33 wherein the electromagnetic radiation is of a type selected from the group consisting of visible radiation, infrared radiation, and ultraviolet radiation.

36. The method of claim 33 wherein the sensors are optical sensors.

37. The method of claim 36 wherein the optical sensors comprise photodiodes.

38. The method of claim 37 wherein the output signals are derived from the intensity of light radiation received at the photodiodes.

39. The method of claim 33 wherein each of the sensors has a corresponding viewing angle having a center line, and wherein the center lines are at known orientations relative to each other.

40. The method of claim 33 wherein the center lines of the respective sensors are at angles relative to each other.

41. The method of claim 40 wherein the center lines lie on a plane.

42. The method of claim 41 wherein the center lines intersect at a common point.

43. The method of claim 33 further comprising sampling multiple sets of the sensor output signals at periodic time intervals.

44. The method of claim 33 wherein determining the actual position of the source of electromagnetic energy is based on multiple sets of the sensor output signals.

45. The method of claim 33 further comprising:

determining a subset of the output signals of the sensors having signal levels that are greater than those of other output signals;

fitting a polynomial to the output signals of the subset;

determining one of a maximum and minimum of the polynomial; and

determining the actual position of the source of electromagnetic energy based on the one of the maximum and minimum.

46. The method of claim 45 wherein the subset includes at least three of the sensor output signals.

47. The method of claim 33 wherein computing a theoretical position of the source of electromagnetic energy is based on a known factor selected from the types consisting of: time, latitude, longitude, and altitude.

48. The method of claim 18 wherein the plurality of sensors comprises a two-dimensional array of sensors.

49. The method of claim 48 wherein the two-dimensional array of sensors comprises a charge-coupled device (CCD) array.